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(19)(CA) APPLICATION FOR CANADIAN PATENT (12)

(54) Telephone Activity Monitor

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ABSTRACT OF THE DISCLOSURE

A device for detecting outgoing and received telephone calls and communicating the telephone number and length of call in the case of outgoing calls and the length of call in the case of received calls. The device connects to the standard telephone service to detect telephone calls and communicates information about telephone line activity to an external device.

TELEPHONE ACTIVITY MONITOR

The present invention relates to a device for detecting originating and received telephone calls on a standard telephone line and communicating information to another device that allows the other device to determine the telephone number and length of call in the case of originating calls and the length of call in the case of received calls.

Some private branch exchange (PBX) and electronic key systems have the facility to communicate with external devices to indicate the originating calls that are made, the telephone number of the call, and the length of the call. These systems perform this function as part of specialized telephone set equipment and do not perform this function when used with standard telephone sets. They also do not communicate the existence of received calls. These systems have the further disadvantage of being expensive.

It is desirable to have a device that attaches to the telephone service line and allows any telephone set to be used, that is inexpensive, and that will provide communications indicating that the handset of any telephone on the line has been placed off-hook, that the handset has been placed on-hook, and the number that is dialed when the handset is off-hook. The present invention relates to a device that provides these features.

The present invention is an electronic device that connects to a standard telephone service line and communicates with an external computer or communications device or system information indicating that the telephone handset has been taken off-hook, that the telephone handset has been placed on-hook, the pushbutton pressed in the case of a pushbutton telephone, and information about the number dialed in the case of a rotary dial telephone.

The invention consists of an isolation unit, a DTMF (Dual Tone Multiple Frequency) decoder, a control unit, and a communications unit.

The isolation unit connects to the telephone line and electrically isolates the rest of the device from the telephone line. It provides two interfaces to the rest of the device. An analog interface provides all audio signals that appear on the telephone line to the rest of the system. A digital interface provides an output that indicates whether the telephone set is on-hook or off-hook by monitoring the telephone line voltage.

The DTMF decoder accepts audio signals from the isolation unit and decodes them to indicate when a key is pressed and which key is pressed on the telephone set for telephone sets that generate DTMF tones. The output from the DTMF decoder is a digital signal.

The control unit consists of a microprocessor or microcontroller with associated program storage. It accepts the digital output from the isolation unit that indicates the voltage level of the telephone line, and the digital output from the DTMF decoder that indicates that a key on DTMF tone generating telephone set has been pressed and the identity of the key. Using this digital information from the isolation unit and the DTMF decoder, the control unit passes to the communications unit information indicating that the telephone handset has been taken off-hook, that the telephone handset has been placed on-hook, the pushbutton pressed in the case of a pushbutton telephone, and information about the number dialed in the case of a rotary dial telephone. In the case of a rotary dial telephone set or a pushbutton pulse dial

telephone set the control unit determines the number dialed by timing how long the telephone line is at the on-hook and off-hook voltage levels as indicated by the digital output from the interface unit. The length of time that the telephone line remains at the on-hook and off-hook voltage levels indicates whether the telephone set is pulse dialing or has been placed on-hook or off-hook. The number of these pulse dial transitions indicates the number dialed.

The communications unit accepts messages from the control unit and sends these messages to external devices, converting the digital signals received from the control unit to the voltage and current levels required to interface with an external device or system.

Figure 1 is a block diagram of the invention which shows the component functions of the system as described above.

The invention, as exemplified by a preferred embodiment, is described with reference to Figure 2, which is a circuit diagram of an embodiment of the invention. The diagram layout in Figure 2 roughly corresponds to the functional block diagram layout in Figure 1.

Referring to Figure 2, the embodiment of the invention shown, the Telephone Activity Monitor has three external interfaces. Interface P1 connects to the telephone service line. Interface J1 allows a telephone set to be connected to the telephone line. Interface P2 is a serial communications output that transmits information to an external device or system.

The interface unit described above and in Figure 1 comprises transformer T1, opto-isolator U5, and transistor Q1 in Figure 2. Transformer T1 provides electrical isolation from the telephone service line for an audio interface to the rest of the device. Transistor Q1 and associated resistors R2, R3, and R4 amplifies this audio signal to provide sufficient voltage for the DTMF decoder. Opto-isolator U5 also provides electrical isolation from the telephone service line while allowing the control unit to detect the state of the telephone line voltage. Current-limiting resistor R6 provides an operating threshold for opto-isolator U5 such that the current between the anode and cathode of the light emitting diode in opto-isolator U5 is sufficient to allow emitter current in the output of the opto-isolator when a telephone set on the telephone service line is on-hook, but the current between the anode and cathode of the light emitting diode in opto-isolator U5 is not sufficient to allow emitter current in the output of the opto-isolator when a telephone set is off-hook. This current is converted to a voltage level by resistor R7 such that a high voltage level appears at the emitter output of the opto-isolator when the telephone set is on-hook and a low voltage level appears at the emitter output of the opto-isolator when the telephone set is off-hook.

The DTMF decoder described above and in Figure 1 comprises integrated circuit U4 in Figure 2. It takes the audio signal from the collector of transistor Q1 in the interface unit and decodes any valid DTMF signal into a 4-bit binary code and a data valid signal. Crystal X2 provides a timebase for the DTMF decoder.

The control unit described above and in Figure 1 comprises microprocessor U1, latch U2, and EPROM U3 in Figure 2. Microprocessor U1 accepts a digital voltage level from opto-isolator U5 into its port P1.5, which is a high level if the telephone is on-hook and a low level if the telephone is off hook. If the telephone on the line is a pulse dial type, the digital signal at the microprocessor's port P1.5 will be pulses corresponding to the dial pulses on

the telephone service line. Microprocessor U1 also accepts the decoded DTMF key code from DTMF decoder U4 on its ports P1.0, P1.1, P1.2, and P1.3 when the data valid signal on microprocessor port P1.4 is at a high logic level.

The microprocessor U1 detects that the telephone has changed from an on-hook state to an off-hook state by the voltage level on its port P1.5 changing from a logic high voltage level to a logic low voltage level and remaining at the logic low voltage level for a time period greater than the time period between individual pulses in a pulse dial telephone set. When this change from on-hook to off-hook state is detected by the microprocessor, the microprocessor constructs a message indicating this change and sends it from its TXD port to the communication unit, which is shown as U6 in Figure 2.

The microprocessor similarly detects that the telephone has changed from an off-hook state to an on-hook state by the voltage level on its port P1.5 changing from a logic low voltage level to a logic high voltage level and remaining at the logic high voltage level for a time period greater than the pulse width of individual pulses in a pulse dial telephone set. When this change is detected by the microprocessor, the microprocessor constructs a message indicating this change and sends it from its TXD port to the communication unit.

When the microprocessor has detected that the telephone is in an off-hook state and the DTMF data valid signal at port P1.4 is active, the microprocessor reads the decoded key number at its ports P1.0, P1.1, P1.2, and P1.3. It then constructs a message indicating the number dialed and sends it from its TXD port to the communication unit.

When the microprocessor has detected that the telephone is in an off-hook state and the telephone line voltage as indicated at port P1.5 changes to an on-hook voltage then back to an off-hook voltage after a period of time less than the maximum pulse width for a rotary dial telephone set, it then starts to time the period that the telephone line voltage remains at the off-hook state. If this length of time is less than the maximum period between pulses for a pulse dial telephone set, it accumulates this number as part of the telephone number dialed. If it is longer than this maximum time period, the microprocessor takes the accumulated number of pulses and constructs a message indicating the number dialed as the accumulated number of pulses and sends it from its TXD port to the communication unit.

Figure 3 shows the software flow chart for the microprocessor's control algorithm described above.

The communications unit described above and in Figure 1 comprises integrated circuit U6 in Figure 2. This integrated circuit receives the transmit data from the TXD port of the microprocessor U1 and converts it to the proper voltage levels and provides the proper current drive for standard RS-232C communications. This RS-232C data is available to external devices on the P2 interface.

Although only a single embodiment of the present invention has been described and illustrated, the present invention is not limited to the features of this embodiment, but includes all variations and modifications within the scope of the claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. An electronic device that conects to the telephone service line that detects outgoing and received telephone calls, and that communicates information regarding these telephone calls to an external computing device or communications device or system, comprising:

an isolation unit to prevent interference with the operation of the telephone line;

a DTMF (Dual Tone Multiple Frequency) decoder accepting audio signals from the isolation unit;

a microprocessor or microcontroller and associated program storage to accept telephone line voltage level information from the isolation unit, and received decoded DTMF signals from the DTMF decoder, and to construct and send messages indicating telephone line activity to external devices;

a communications unit to receive outgoing messages from the microprocessor or microcontroller unit and interface with external devices, sending these messages over an external wire using the correct protocol for the external devices including any interaction with external communications devices and fulfilling any communications line voltage and current requirements.

2. A device as claimed in claim 1, wherein the device can communicate to an external computing device or communications device or system, information regarding origination and reception of telephone calls, telephone number of originated calls, and duration of received and originated calls.

3. A device as claimed in claim 1, wherein a telephone set, which can be a pulse dial type, a tone dial type, the base station of a cordless type, or a mobile cellular type, can be connected to the device and the device in turn can be connected to the telephone service line, without modifying or affecting the normal use of the telephone set or telephone sevice line.

4. A device as claimed in claim 1, connected as in claim 3, such that when the handset of the telephone set connected to the telephone line is lifted the device sends a message over its communications line indicating that the handset has been lifted, and when the handset is replaced on the telephone set the device sends a message over its communications line indicating that the handset has been replaced.

5. A device as claimed in claim 1, connected as in claim 3, such that when the handset of the telephone set connected to the telephone line is lifted and the telephone set is a pulse dial type, the device sends a message over the communications line indicating the number dialed on the telephone set until the telephone handset is replaced on the telephone set.

6. A device as claimed in claim 1, connected as in claim 3, such that when the handset of the telephone set connected to the telephone line is lifted and the telephone set is a tone dial type, the device sends a message over the communications line indicating the number pressed on the telephone set until the telephone handset is replaced on the telephone set.

Figure 1

Device Block Diagram

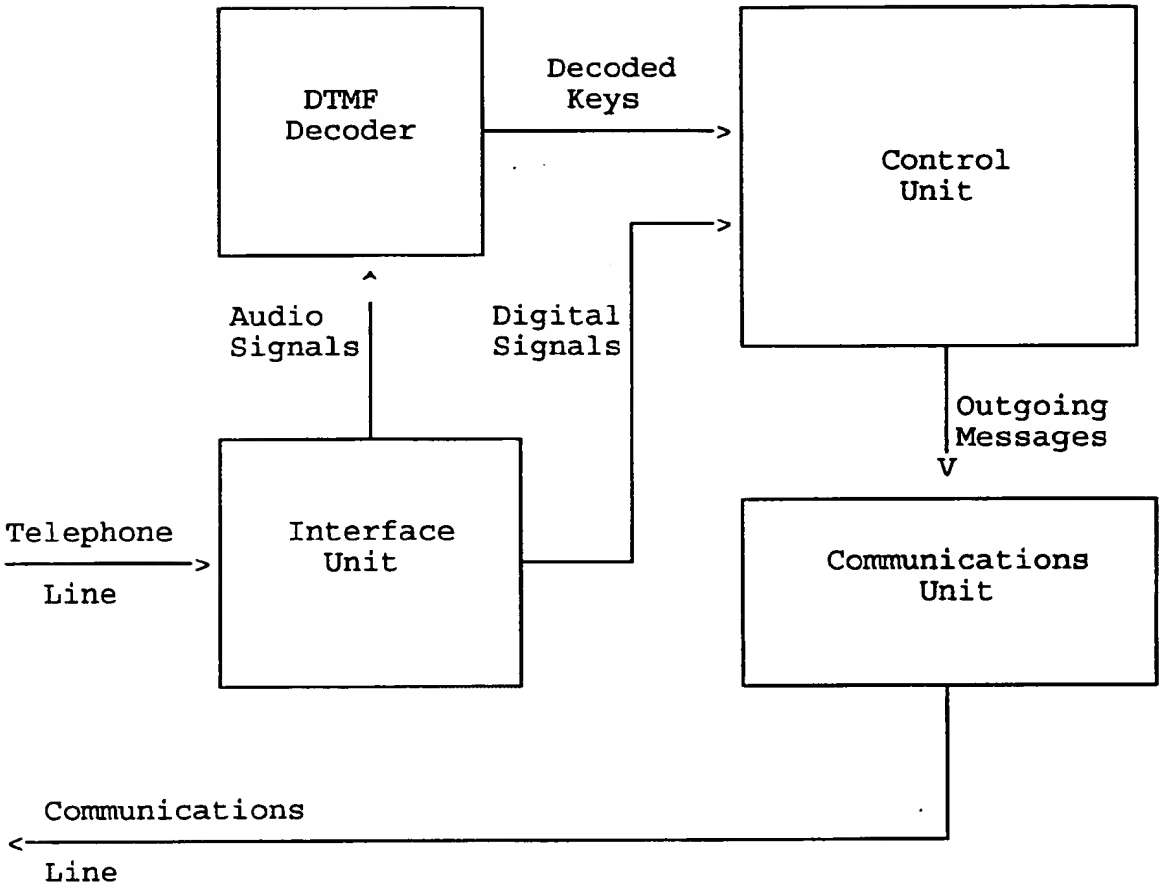

Figure 2
Device Cicuit Diagram

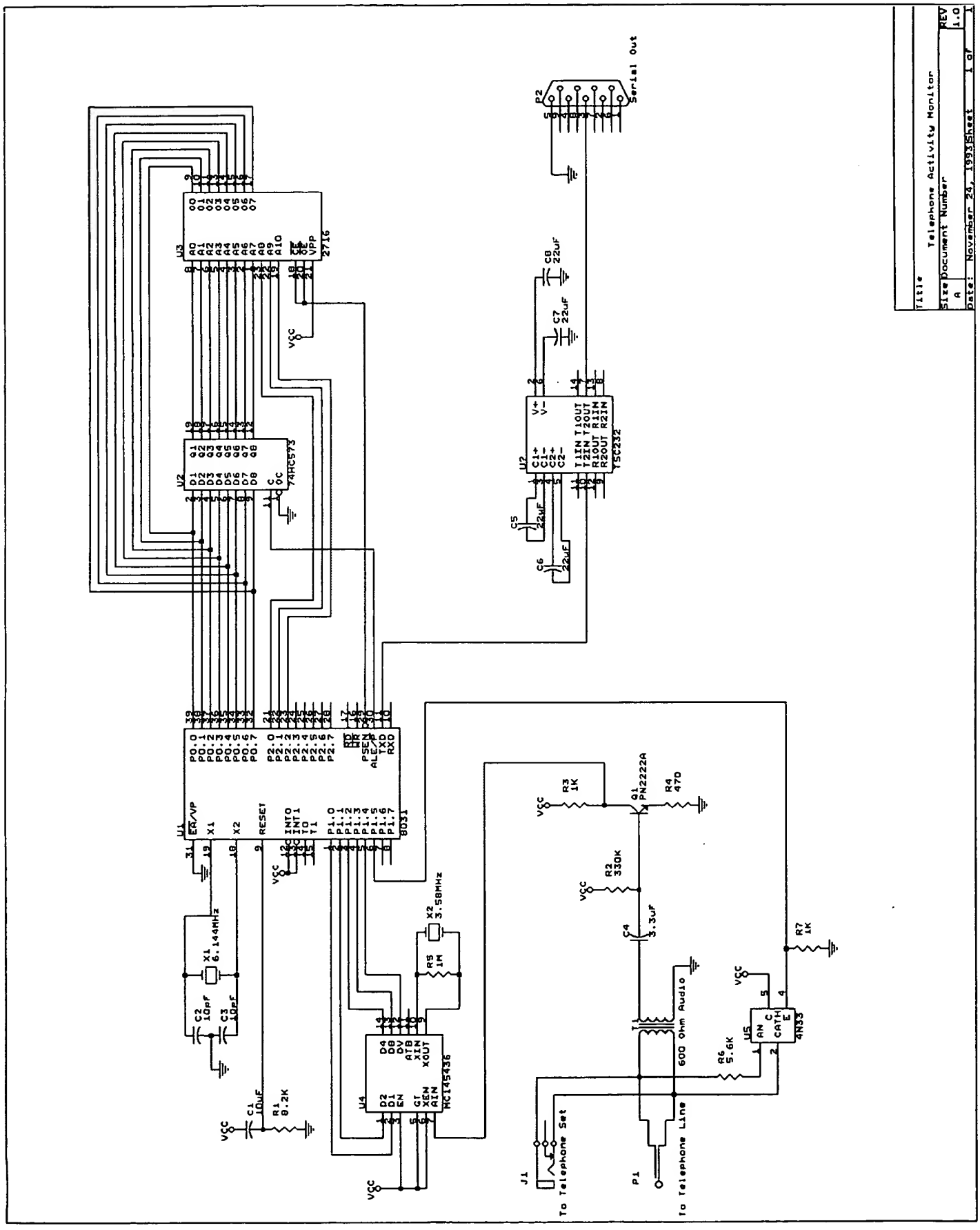

Figure 3
Microprocessor Control Flow Chart